APPENDIX E.
Entry and Advancement in the Arizona Construction and Engineering Industries

Federal courts have found that Congress "spent decades compiling evidence of race discrimination in government highway contracting, of barriers to the formation of minority-owned construction businesses, and of barriers to entry."[1] Congress found that discrimination had impeded the formation of qualified minority-owned businesses. In the marketplace appendices (Appendix E through Appendix I), Keen Independent examines whether some of the barriers to business formation that Congress found for minority- and women-owned businesses also appear to occur in Arizona.

Potential barriers to business formation include barriers associated with entry and advancement in the construction and engineering industries. Appendix E examines recent data on education, employment, and workplace advancement that may ultimately influence business formation in the Arizona construction and engineering industries.[2,3]

Introduction

Keen Independent examined whether there were barriers to the formation of minority- and women-owned businesses in Arizona. Business ownership often results from an individual entering an industry as an employee and then advancing within that industry. Within the entry and advancement process, there may be some barriers that limit opportunities for minorities and women. Figure E-1 presents a model of entry and advancement in the construction and engineering industries.

Appendix E uses 2000 Census data and 2008-2012 American Community Survey (ACS) data to analyze education, employment, and workplace advancement — all factors that may influence whether individuals start construction or engineering businesses. Keen Independent studied barriers to entry into construction and engineering separately, because entrance requirements and opportunities for advancement differ for those industries.

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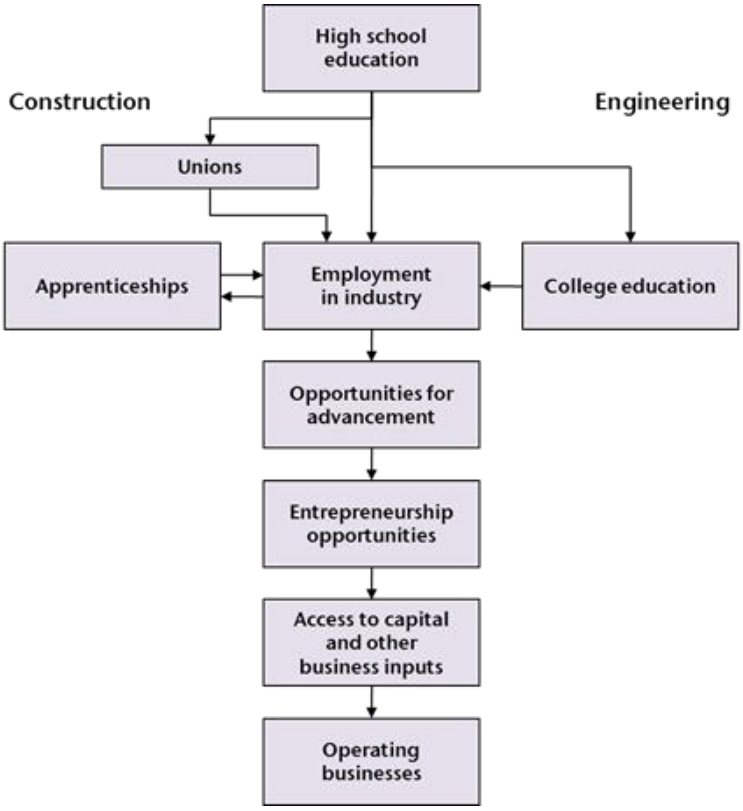
[1] *Sherbrooke Turf, Inc.*, 345 F.3d 964 (8th Cir. 2003) at 970 (citing *Adarand Constructors, Inc.*, 228 F.3d at 1167 – 76); *Western States Paving Co. v. Washington State DOT*, 407 F.3d 983 (9th Cir. 2005) at 992.

[2] In Appendix E and other appendices that present information about local marketplace conditions, information for "engineering" refers to architectural, engineering and related services. Each reference to "engineering" work pertains to those types of services. In the 2000 Census industrial classification system, "Architectural, engineering and related services" was coded as 729. In the 2008-2012 ACS, the same industry was coded as 7290.

[3] Several other report appendices analyze other quantitative aspects of conditions in the Arizona marketplace. Appendix F explores business ownership. Appendix G presents an examination of access to capital. Appendix H considers the success of businesses. Appendix I presents the data sources that Keen Independent used in those appendices.

Figure E-1.
Model for studying entry into the construction and engineering industries

Source:
Keen Independent.



Representation of minorities among workers and business owners in Arizona. As a starting point, Keen Independent examined the representation of racial/ethnic minorities among business owners and workers in Arizona. Figure E-2 shows the demographic distribution of business owners in construction and engineering, business owners in other industries (excluding construction and engineering) and the labor force, based on 2008-2012 ACS data. (Demographics of the construction and engineering industries workforce are presented separately later in Appendix E.) The demographic analysis for Arizona in 2008-2012 indicated the following:

- African Americans accounted for only 1 percent of business owners in construction and engineering, 2 percent of business owners in other industries and about 4 percent of all workers.
- Asian Americans also accounted for 1 percent of business owners in construction and engineering, about 5 percent of business owners in other industries and about 4 percent of all workers;
- Hispanic Americans accounted for about 26 percent of business owners in construction and engineering, 21 percent of business owners in other industries and 27 percent of all workers.
- Native Americans and other minorities accounted for approximately 2 percent of all business owners in construction and engineering, 2 percent of owners in other industries and 4 percent of all workers.
- Non-Hispanic whites accounted for about 71 percent of business owners in construction and engineering, 70 percent of business owners in other industries and 61 percent of all workers.

Figure E-2.
Demographic distribution of business owners and the workforce, 2008-2012

Arizona	Business owners in construction and engineering		Business owners in all other industries	Workforce in all industries
Race/ethnicity				
African American	1.0 %	**	1.9 %	4.2 %
Asian American	0.9	**	4.7	3.6
Hispanic American	25.7	**	21.0	27.2
Native American or other minority	1.7		2.0	4.0
Total minority	29.3 %		29.6 %	39.0 %
Non-Hispanic white	70.7		70.4	61.0
Total	100.0 %		100.0 %	100.0 %
Gender				
Female	11.5 %	**	42.6 %	46.2 %
Male	88.5	**	57.4	53.8
Total	100.0 %		100.0 %	100.0 %

Note: *,** Denote that the difference in proportions between business owners in construction and engineering and business owners in all other industries for the given race/ethnicity/gender group is statistically significant at the 90% or 95% confidence level, respectively. The Engineering industry includes "architectural, engineering and related services."

Source: Keen Independent Research from 2008-2012 ACS Public Use Microdata Sample (PUMS). The 2008-2012 raw data extracts were obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Keen Independent analyzed demographic data to determine if the differences in business ownership in construction and engineering and business ownership in other industries by race/ethnicity were statistically significant and found:

- Relatively fewer African American business owners in construction and engineering compared to African American business owners in other industries;
- Relatively fewer Asian American business owners in construction and engineering compared to Asian American business owners in other industries; and
- Relatively more Hispanic American business owners in construction and engineering compared to Hispanic American business owners in other industries.

Representation of women among business owners and workers in Arizona. Figure E-2 also examines the percentage of Arizona business owners and workers who are women. In 2008-2012, women accounted for about 12 percent of business owners in construction and engineering, significantly less than their representation among business owners in other industries (43 percent). During this period, women comprised 46 percent of the Arizona labor force.

Construction Industry

Keen Independent examined how education, training, employment and advancement may affect the number of businesses that individuals of different races/ethnicities and genders owned in the Arizona construction industry in 2000 and in 2008-2012.

Education. Formal education beyond high school is not a prerequisite for most construction jobs. For that reason, the construction industry often attracts individuals who have less formal education. Based on 2008-2012 ACS data, 34 percent of workers in the Arizona construction industry were high school graduates with no post-secondary education and 25 percent had not finished high school. Only 10 percent of those working in the Arizona construction industry had a four-year college degree or higher, compared to 28 percent of workers in other industries in the state.

Race/ethnicity. Based on educational requirements of entry-level jobs and the limited education beyond high school for many Hispanic Americans, Native Americans and African Americans in Arizona, one would expect a relatively high representation of those groups in the Arizona construction industry, especially in entry-level positions.

- Hispanic Americans represented an especially large pool of Arizona workers with no post-secondary education. In 2008-2012, only 10 percent of all Hispanic American workers 25 and older who worked in Arizona held at least a four-year college degree, far below the figure for non-Hispanic whites working in the state (32%).
- The percentage of Native American (12%) and African American (23%) workers in Arizona with a four-year college degree was also substantially lower than that of non-Hispanic whites in 2008-2012.

Almost one-half (48%) of Asian American workers 25 and older in Arizona had four-year college degrees in 2008-2012. One might expect representation of Asian Americans in the Arizona construction industry to be lower than in other industries given this level of education.

Gender. On average, female workers in Arizona have a similar level of education as men. Based on 2008-2012 data, 26 percent of female workers and 25 percent of male workers age 25 and older had at least a four-year college degree.

Apprenticeship and training. Training in the construction industry is largely on-the-job and through trade schools and apprenticeship programs. Entry-level jobs for workers out of high school are often for laborers, helpers, or apprentices. More skilled positions in the construction industry may require additional training through a technical or trade school or through an apprenticeship or other employer-provided training program. Apprenticeship programs can be developed by employers, trade associations, trade union, or other groups.

Workers can enter apprenticeship programs from high school or trade school. Apprenticeships have traditionally been three- to five-year programs that combine on-the-job training with classroom instruction.[4] Opportunities for those programs across racial and ethnic groups are discussed later in Appendix E.

Employment. With educational attainment for minorities and women as context, Keen Independent examined employment in the Arizona construction industry. Figure E-3 presents data from 2000 and 2008-2012 to compare the demographic composition of the construction industry with the total workforce in Arizona.

Race/ethnicity. Based on 2008-2012 ACS data, 47 percent of people working in the Arizona construction industry were minorities, up from 40 percent in 2000. The increase was due to growth in the number of Hispanic American construction workers. Examination of the Arizona construction industry workforce in 2008-2012 shows that:

- 39 percent was made up of Hispanic Americans;
- 1 percent was made up of African Americans;
- 1 percent was made up of Asian Americans; and
- 5 percent was made up of Native Americans and other minorities.

In Arizona, Hispanic Americans made up a significantly larger percentage of workers in construction (39%) than in other industries (26%). Native Americans also were a larger percentage of workers in construction (5%) than in other industries (4%). In contrast, African Americans (1%) and Asian Americans (1%) accounted for a smaller percentage of workers in the construction industry than in other industries (4% and 4%, respectively). Figure E-3 provides these results.

The average educational attainment of African Americans is consistent with requirements for construction jobs, so education does not explain the relatively low number of African American workers in the Arizona construction industry. Several studies throughout the United States have argued that race discrimination by construction unions has contributed to the low employment of African Americans in construction trades.[5] The role of unions is discussed more thoroughly later in Appendix E (including research that suggests discrimination has been reduced in unions).

[4] Bureau of Labor Statistics, U.S. Department of Labor. 2006-07. "Construction." *Career Guide to Industries.* http://www.bls.gov/oco/cg/cgs003.htm (accessed February 15, 2007).

[5] Waldinger, Roger and Thomas Bailey. 1991. "The Continuing Significance of Race: Racial Conflict and Racial Discrimination in Construction." *Politics & Society*, 19(3).

Asian Americans made up 1 percent of the construction workforce and 4 percent of all other workers in Arizona in 2008-2012. The fact that Asian Americans were more likely than other groups to have a college education may explain part of that difference.

Figure E-3.
Demographics of workers in construction and all other industries, 2000 and 2008-2012

	Construction		All other industries	
Arizona	**2008-2012**	**2000**	**2008-2012**	**2000**
Race/ethnicity				
African American	1.4 % **	1.6 % **	4.4 %	3.3 %
Asian American	0.8 **	0.8 **	3.9	2.6
Hispanic American	39.4 **	32.5 **	26.2	20.4
Native American or other minority	5.3 **	5.3 **	3.9	4.1
Total minority	46.8 %	40.1 %	38.4 %	30.5 %
Non-Hispanic white	53.2 **	59.9 **	61.6	69.5
Total	100.0 %	100.0 %	100.0 %	100.0 %
Gender				
Female	10.7 % **	11.0 % **	49.2 %	48.3 %
Male	89.3 **	89.0 **	50.8	51.7
Total	100.0 %	100.0 %	100.0 %	100.0 %

Note: *,** Denote that the difference in proportions between workers in the construction industry and all other industries for the given Census/ACS year is statistically significant at the 90% or 95% confidence level, respectively.

Source: Keen Independent Research from 2000 U.S. Census 5% sample and 2008-2012 ACS Public Use Microdata samples. The 2000 Census and 2008-2012 ACS raw data extracts were obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Foreign-born workers. A substantial portion of Arizona construction workers are foreign-born and the vast majority (about 90%) are Hispanic American based on ACS data.

- In 2000, 23 percent of the Arizona construction workers were foreign-born.
- By 2007, 34 percent of the Arizona construction workforce was foreign-born.
- In the 2008 to 2012 time period, foreign-born workers were 24 percent of the Arizona construction workforce.[6]

[6] The ACS may not fully reflect undocumented workers due to undercounting. The Department of Homeland Security estimates the undercount is about 5 percent.

The change in composition of the foreign-born construction workforce since 2007 may be a result of several factors, including:

- Changes in state laws concerning employer verification in 2007 with the passage of the Legal Arizona Workers Act (LAWA), which mandated the use of E-Verify for Arizona employers;
- Additional state laws enacted in 2010 with the passage of the Support Our Law Enforcement and Safe Neighborhoods Act (SB1070) regarding immigration enforcement; and
- The Great Recession.

Recent research indicates the passage of LAWA resulted in a decrease in the population of foreign-born workers and Hispanic non-citizens in Arizona as compared with similar states that did not enact such legislation (comparable states in the research had been chosen based on pre-LAWA population and employment trends).[7] Similar research suggests that one result of this legislation was a doubling of the historic self-employment rate among non-citizen Hispanic males with a high school education or less, because entering into independent contractor agreements versus wage and salary employment avoids E-Verify.[8] This research also estimates the effects of the legislation separately from the effects of the recession by comparing the average difference in foreign-born workers between Arizona and comparable states before and after the enactment of LAWA. Results suggest that both events led to a decrease in the foreign-born Arizona workforce.

Gender. There are large differences in the representation of women in construction compared with women in all industries. For 2008-2012, women represented 11 percent of all construction workers and 49 percent of workers in the state.

Academic research concerning any effect of race- and gender-based discrimination. There is substantial academic literature that has examined whether race- or gender-based discrimination affects opportunities for minorities and women to enter construction trades in the United States. Many studies indicate that race- and gender-based discrimination affects opportunities for minorities and women in the construction industry. For example, the literature concerning women in construction trades has identified substantial barriers to entry and advancement due to gender discrimination and sexual harassment.[9] Research concerning highway construction projects in three major U.S. cities (Boston, Los Angeles, and Oakland) identified evidence of prevailing attitudes that women do not belong in construction, and that such discrimination was worse for women of color than for white women.[10]

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[7] Bohn, S., M. Lofstrum and S. Raphael. May 2014. "Did the 2007 Legal Arizona Workers Act Reduce the State's Unauthorized Immigrant Population?" Review of Economics and Statistics 96.2: 258-269.

[8] Lofstrum, M., S. Bohn and S. Raphael. March 2011. "Lessons from the 2007 Legal Arizona Workers Act." Public Policy Institute of California.

[9] See, for example, Erickson, Julia A and Donna E. Palladino. 2009. "Women Pursuing Careers in Trades and Construction." *Journal of Career Development*. 36(1): 68-89.

[10] Note that those interviews took place between 1996 and 1999. Price, Vivian, 2002. "Race, Affirmative Action and Women's Participation in U.S. Highway Construction." *Feminist Economics*. 8(2), 87-113.

Importance of unions to entry in the construction industry. Labor researchers characterize construction as a historically volatile industry that is sensitive to business cycles, making the presence of labor unions important for stability and job security within the industry.[11] The temporary nature of construction work results in uncertain job prospects, and the relatively high turnover of laborers presents a disincentive for construction firms to invest in training. Some researchers have claimed that constant turnover has lent itself to informal recruitment practices and nepotism, compelling laborers to tap social networks for training and work. They credit the importance of social networks with the high degree of ethnic segmentation in the construction industry.[12] Unable to integrate themselves into traditionally white social networks, African Americans and other minorities faced long-standing historical barriers to entering into the industry.[13]

Construction unions aim to provide a reliable source of labor for employers and preserve job opportunities for workers by formalizing the recruitment process, coordinating training and apprenticeships, enforcing standards of work, and mitigating wage competition. The unionized sector of construction would seemingly be the best road for African Americans and other underrepresented groups into the industry. However, some researchers have identified racial discrimination by trade unions that has historically prevented minorities from obtaining employment in skilled trades.[14] Some researchers argue that union discrimination has taken place in a variety of forms, including the following examples:

- Unions have used admissions criteria that adversely affect minorities. In the 1970s, federal courts ruled that standardized testing requirements for unions unfairly disadvantaged minority applicants who had less exposure to testing. In addition, the policies that required new union members to have relatives who were already in the union perpetuated the effects of past discrimination.[15]
- Of those minority individuals who are admitted to unions, a disproportionately low number are admitted into union-coordinated apprenticeship programs. Apprenticeship programs are an important means of producing skilled construction laborers, and the reported exclusion of African Americans from those programs has severely limited their access to skilled occupations in the construction industry.[16]
- Although formal training and apprenticeship programs exist within unions, most training of union members takes place informally through social networking. Nepotism characterizes the unionized sector of construction as it does the non-unionized sector, and that practice favors a white-dominated status quo.[17]

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[11] Applebaum, Herbert. 1999. Construction Workers, U.S.A. Westport: Greenwood Press.

[12] Waldinger, Roger and Thomas Bailey. 1991. "The Continuing Significance of Race: Racial Conflict and Racial Discrimination in Construction." *Politics & Society*, 19(3).

[13] Feagin, Joe R. and Nikitah Imani. 1994. "Racial Barriers to African American Entrepreneurship: An Exploratory Study." Social Problems. 41(4): 562-584.

[14] U.S. Department of Justice. 1996. Proposed Reforms to Affirmative Action in Federal Procurement. 61 FR 26042.

[15] *Ibid.* See United States v. Iron Workers Local 86 (1971), Sims v. Sheet Metal Workers International Association (1973), and United States v. International Association of Bridge, Structural and Ornamental Iron Workers (1971).

[16] Applebaum. 1999. Construction Workers, U.S.A.

[17] *Ibid.* 299. A high percentage of skilled workers reported having a father or relative in the same trade. However, the author suggests this may not be indicative of current trends.

- Traditionally, white unions have been successful in resisting policies designed to increase African American participation in training programs. The political strength of unions in resisting affirmative action in construction has hindered the advancement of African Americans in the industry.[18]
- Discriminatory practices in employee referral procedures, including apportioning work based on seniority, have precluded minority union members from having the same access to construction work as their white counterparts.[19]
- According to testimony from African American union members, even when unions implement meritocratic mechanisms of apportioning employment to laborers, white workers are often allowed to circumvent procedures and receive preference for construction jobs.[20]

However, more recent research suggests that the relationship between minorities and unions has been changing. As a result, historical observations may not be indicative of current dynamics in construction unions. Recent studies focusing on the role of unions in apprenticeship programs have compared minority and female participation and graduation rates for apprenticeships in joint programs (that unions and employers organize together) with rates in employer-only programs. Many of those studies conclude that the impact of union involvement is generally positive or neutral for minorities and women, compared to non-Hispanic white males, as summarized below.

- Glover and Bilginsoy analyzed apprenticeship programs in the U.S. construction industry during 1996 through 2003. Their dataset covered about 65 percent of apprenticeships during that time. The authors found that joint programs had "much higher enrollments and participation of women and ethnic/racial minorities" and exhibited "markedly better performance for all groups on rates of attrition and completion" compared to employer-run programs.[21]
- In a similar analysis focusing on female apprentices, Bilginsoy and Berik found that women were most likely to work in highly-skilled construction professions as a result of enrollment in joint programs as opposed to employer-run programs. Moreover, the effect of union involvement in apprenticeship training was higher for African American women than for white women.[22]
- Additional research on the presence of African Americans and Hispanic Americans in apprenticeship programs found that African Americans were 8 percent more likely to be enrolled in a joint program than in an employer-run program. However, Hispanic Americans were less likely to be in a joint program than in an employer-run program.[23] Those data suggest

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[18] Waldinger and Bailey. 1991. "The Continuing Significance of Race: Racial Conflict and Racial Discrimination in Construction."

[19] U.S. Department of Justice. 1996. Proposed Reforms to Affirmative Action in Federal Procurement. 61 FR 26042. See *United Steelworkers of America v. Weber* (1979) and *Taylor v. United States Department of Labor* (1982).

[20] Feagin and Imani. 1994. "Racial Barriers to African American Entrepreneurship: An Exploratory Study." *Social Problems*. 41 (4): 562-584.

[21] Glover, Robert and Bilginsoy, Cihan. 2005. "Registered Apprenticeship Training in the U.S. Construction Industry." *Education & Training,* Vol. 47, 4/5, p 337.

[22] Günseli Berik, Cihan Bilginsoy. 2006. "Still a wedge in the door: women training for the construction trades in the USA", *International Journal of Manpower*, Vol. 27 Iss: 4, pp.321 – 341.

[23] Bilginsoy, Cihan. 2005. "How Unions Affect Minority Representation in Building Trades Apprenticeship Programs." *Journal of Labor Research, 57(1).*

that Hispanic Americans may be more likely than African Americans to enter the construction industry without the support of a union.

Other research focusing on specific states also indicates a more productive relationship between unions and minority workers than that which may have prevailed in the past. A study by Berik, Bilginsoy and Williams found minority and white women were overrepresented in union apprenticeship programs in Oregon. Although white women and minorities were less likely to graduate compared to white men, graduation rates for those groups in the union apprenticeship programs were higher than for nonunion programs.[24] Similar research conducted over a ten-year period in Massachusetts found women and minorities were recruited at a higher rate for union apprenticeship programs compared to nonunion programs and that the completion rates for these groups in union programs were consistently higher than those of nonunion programs.[25]

Recent union membership data support those findings as well. For example, 2012 Current Population Survey (CPS) data indicate that union membership rates for African Americans is slightly higher than for non-Hispanic whites and union membership rates for Hispanic Americans are similar to those of non-Hispanic whites.[26] The CPS asked participants, "Are you a member of a labor union or of an employee association similar to a union?" CPS data showed union membership to be 13 percent for African American workers, 10 percent for Hispanic American workers and 11 percent for non-Hispanic white workers. In the construction industry, the union membership rates for both African American workers and non-Hispanic white workers is 17 percent but the rate for Hispanic American construction workers is only 8 percent.

Although union membership and union program participation varies based on race and ethnicity, there is no clear picture from the research about the causes of those differences and their effects on construction industry employment. Research is especially limited concerning the impact of unions on Asian American employment. It is unclear from past studies whether unions presently help or hinder equal opportunity in construction and whether effects in Arizona are different from other parts of the country. In addition, the current research indicates that the effects of unions on entry into the construction industry may be different for different minority groups.

Overall, union membership is declining. Keen Independent researched union membership in Arizona and found only 5 percent of all employed wage and salary workers were members of a labor union or an employee association similar to a union in 2013. Membership had been at 9 percent of employed persons in 2008.[27] Union membership among private sector construction workers in Arizona has decreased from nearly 12 percent in 2008 to 4 percent in 2013.[28]

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[24] Berik, Bilginsoy, and Williams. 2011. "Gender and Racial Training Gaps in Oregon Apprenticeship Programs." *Labor Studies Journal:* 36(2): 221-244.

[25] Argyres, Anneta and Moir, Susan. 2008. "Building Trades Apprentice Training in Massachusetts: An Analysis of Union and Non-Union Programs, 1997-2007". *Labor Resource Center Publications.* Paper 2.

[26] 2012 Current Population Survey (CPS), Merged Outgoing Rotation Groups, U.S. Census Bureau and Bureau of Labor Statistics.

[27] Bureau of Labor Statistics, U.S. Department of Labor. 2014. "Union Membership in Arizona – 2013."

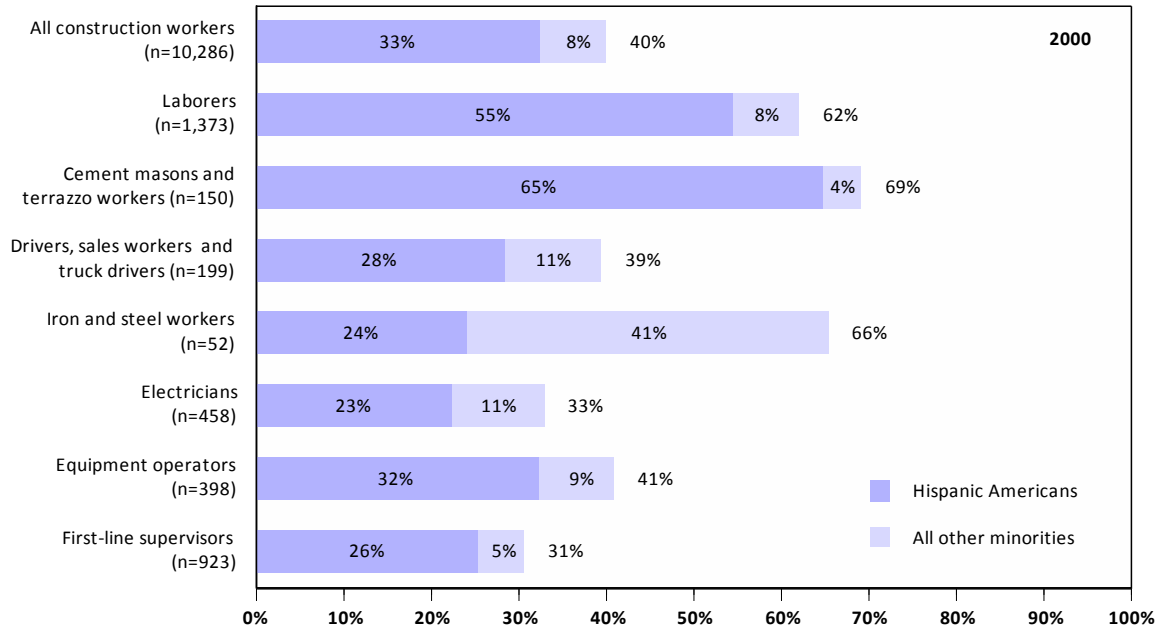
[28] Barry Hirsch and David Macpherson. 2014. "Union Membership and Coverage Database from the CPS." http://unionstats.com (accessed May 6, 2014).

Advancement. To research opportunities for advancement in the Arizona construction industry, Keen Independent examined the representation of minorities and women in construction occupations defined by the U.S. Bureau of Labor Statistics.[29] Appendix I provides full descriptions of construction trades with large enough sample sizes in the 2000 Census and 2008-2012 ACS for analysis.

Racial/ethnic composition of construction occupations. Figures E-4 and E-5 present the race/ethnicity of workers in select construction-related occupations in Arizona, including low-skill occupations (e.g., construction laborers), higher-skill construction trades (e.g., electricians), and supervisory roles. The trades correspond to types of construction labor often involved in transportation contracting. Figure E-4 and E-5 present those data for 2000 and 2008-2012, respectively.

Based on 2000 Census and 2008-2012 ACS data, there are large differences in the racial/ethnic makeup of workers in various trades related to construction in Arizona. Overall, minorities comprised 40 percent of construction workers in 2000 and 47 percent in 2008-2012. Minorities comprised a relatively smaller percentage of construction labor working as electricians, as shown in Figures E-4 and E-5.

Figure E-4.
Minorities as a percentage of selected construction occupations in Arizona, 2000



Note: Crane and tower operators, dredge, excavating and loading machine and dragline operators, paving, surfacing and tamping equipment operators and miscellaneous construction equipment operators were combined into the single category of equipment operators.

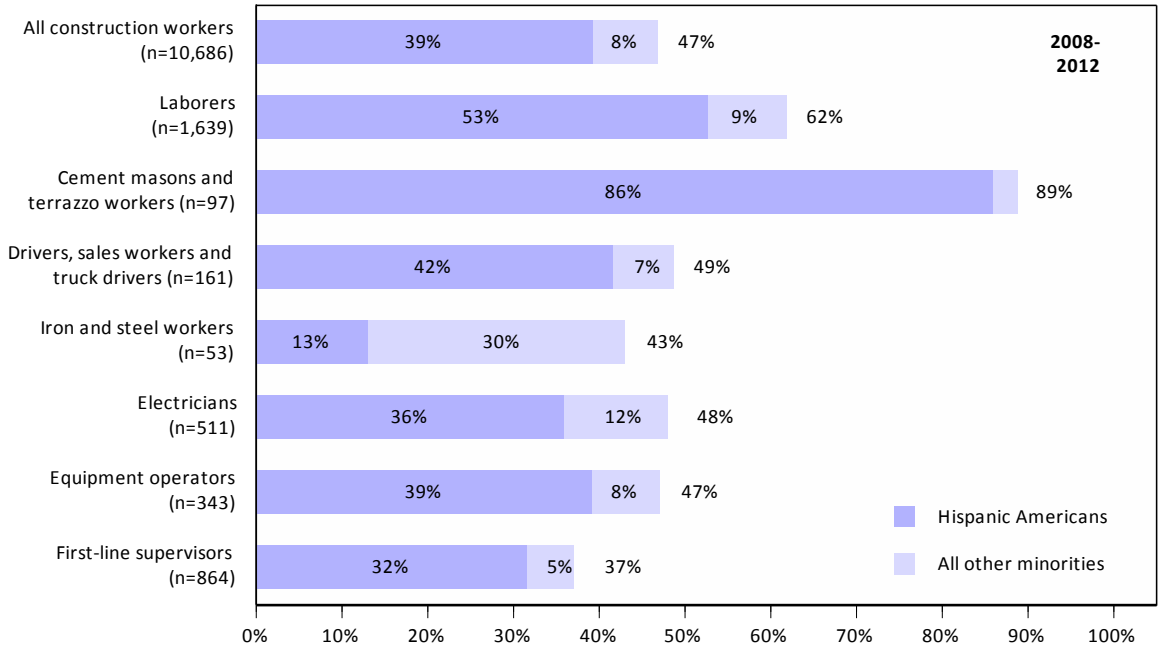
Source: Keen Independent Research from 2000 U.S. Census 5% sample Public Use Microdata samples. The 2000 Census raw data extract was obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

[29] Bureau of Labor Statistics, U.S. Department of Labor. 2001. "Standard Occupational Classification Major Groups." http://www.bls.gov/soc/soc_majo.htm (accessed February 15, 2007).

About 31 percent of first-line supervisors were minorities in 2000, less than the total percentage of Arizona construction workers who were minorities (40%). Minorities made up a larger percentage of first-line supervisors (37%) in 2008-2012, but that percentage was still less than the total percentage of construction workers who were minorities during those years (47%).

Most minorities working in the Arizona construction industry in 2008-2012 were Hispanic Americans (see Figure E-5). The representation of Hispanic Americans was substantially greater among cement masons (86%) and laborers (53%) than among all construction workers (39%). Those occupations tend to be low-skill occupations. Only 32 percent of first-line supervisors in 2008-2012 were Hispanic Americans.

Figure E-5.
Minorities as a percentage of selected construction occupations in Arizona, 2008-2012



Note: Crane and tower operators, dredge, excavating and loading machine and dragline operators, paving, surfacing and tamping equipment operators and miscellaneous construction equipment operators were combined into the single category of equipment operators.

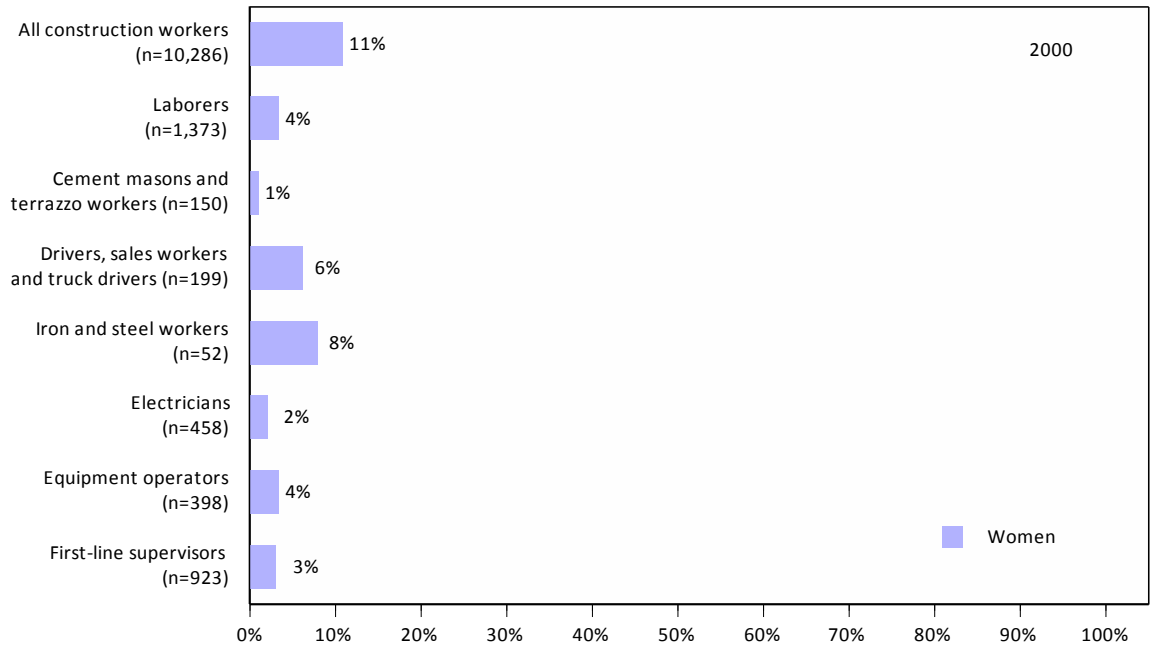
Source: Keen Independent Research from 2008-2012 ACS Public Use Microdata samples. The 2008-2012 ACS raw data extract was obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Gender composition of construction occupations. Keen Independent also analyzed the proportion of women in construction-related occupations. Figures E-6 and E-7 summarize the representation of women in select construction-related occupations for 2000 and 2008-2012, respectively. Overall, women made up only 11 percent of workers in the industry in 2000 and in 2008-2012. Representation of women in all trades either declined during this period or remained relatively unchanged.

In both 2000 and the 2008- 2012 time frame, women comprised no more than 4 percent of workers in the following trades:

- Laborers;
- Cement masons and terrazzo workers;
- Electricians; and
- Equipment operators.

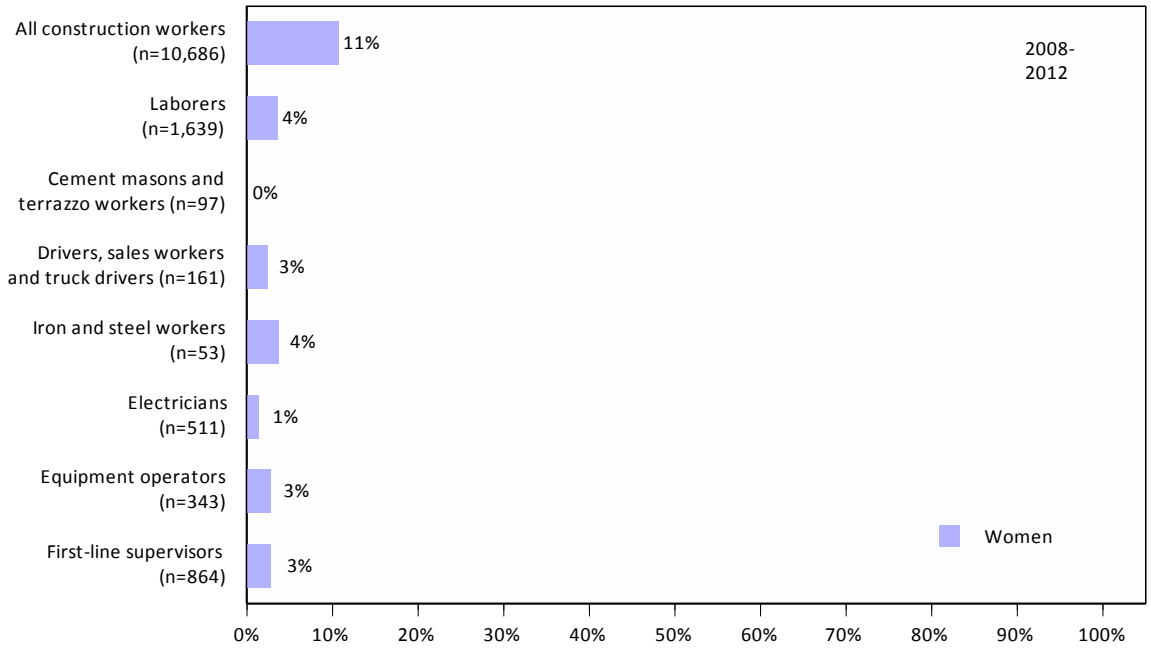
Figure E-6.
Women as a percentage of construction workers in selected occupations in Arizona, 2000



Note: Crane and tower operators, dredge, excavating and loading machine and dragline operators, paving, surfacing and tamping equipment operators and miscellaneous construction equipment operators were combined into the single category of equipment operators.
Source: Keen Independent Research from 2000 U.S. Census 5% sample Public Use Microdata samples. The 2000 Census raw data extract was obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

As shown in Figures E-6 and E-7, women comprised just 3 percent of first-line supervisors.

Figure E-7.
Women as a percentage of construction workers in selected occupations in Arizona, 2008-2012



Note: Crane and tower operators, dredge, excavating and loading machine and dragline operators, paving, surfacing and tamping equipment operators and miscellaneous construction equipment operators were combined into the single category of equipment operators.

Source: Keen Independent Research from 2008-2012 ACS Public Use Microdata samples. The 2008-2012 ACS raw data extract was obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Percentage of minorities and women who are managers. To further assess advancement opportunities for minorities and women in the Arizona construction industry, Keen Independent examined the proportion of construction workers who reported being managers. Figure E-8 presents the percentage of construction employees who reported working as managers in 2000 and 2008-2012 for Arizona and the nation, by racial, ethnic and gender group.

Figure E-8.
Percentage of construction workers who worked as a manager,
2000 and 2008-2012

Arizona	2008-2012		2000	
Race/ethnicity				
African American	4.1 %	**	5.9 %	**
Asian American	5.3	**	4.6	**
Hispanic American	2.8	**	1.9	**
Native American or other minority	1.9	**	2.2	**
Non-Hispanic white	11.5 %		10.5 %	
Gender				
Female	4.4 %	**	5.2 %	**
Male	7.8		7.4	
All individuals	7.4 %		7.2 %	

Note: *,** Denote that the difference in proportions between the minority group and non-Hispanic whites (or between females and males) for the given Census/ACS year is statistically significant at the 90% or 95% confidence level, respectively.

Source: Keen Independent Research from 2000 U.S. Census 5% sample and 2008-2012 ACS Public Use Microdata samples. The 2000 Census and 2008-2012 ACS raw data extracts were obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Racial/ethnic composition of managers. In 2008-2012, about 12 percent of non-Hispanic whites in the Arizona construction industry were managers. A smaller percentage of minority workers were managers:

- About 4 percent of African Americans working in the Arizona construction industry were managers;
- About 5 percent of Asian Americans were managers;
- About 3 percent of Hispanic Americans were managers; and
- About 2 percent of Native American or other minorities were managers.

Although the percentages of minority construction workers working as managers increased from 2000 to the 2008-2012 time period, management representation among minority construction workers remains significantly less than the management representation among non-Hispanic white construction workers.

Gender composition of managers. In the Arizona construction industry, there was also a significant difference in the percentage of women and men that were managers (see Figure E-8). About 8 percent of male construction workers were managers in 2008-2012. Women working in construction were about one-half as likely to be managers.

Engineering Industry

Keen Independent also examined how education and employment may influence the number of potential minority and female entrepreneurs working in the Arizona engineering industry.

Education. In contrast to the construction industry, lack of educational attainment may preclude workers' entry into the engineering industry. Many occupations require at least a four-year college degree and some require licensure. According to the 2008-2012 ACS, 55 percent of individuals age 25 years and older working in the Arizona engineering industry had at least a four-year college degree. Another 12 percent had an associate's degree. About 79 percent of civil engineers age 25 years and older had at least a four-year college degree. Therefore, any barriers to education can restrict employment opportunities, advancement opportunities, and, consequently, business ownership. Any disparities in business ownership rates in engineering-related work could have resulted from the lack of appropriate education for particular racial, ethnic and gender groups.[30]

Race/ethnicity. Figure E-9 presents the percentage of workers age 25 and older with at least a four-year college degree in Arizona. In Arizona, about 36 percent of all non-Hispanic white workers age 25 and older had at least a four-year degree in 2008-2012. For other racial/ethnic groups, the data for Arizona indicated that:

- About 27 percent of African Americans had at least a four-year college degree;
- Only 13 percent of Hispanic Americans had at least a four-year college degree; and
- About 14 percent of Native Americans had at least a four-year college degree.

The level of education necessary to work in the engineering industry may affect employment opportunities for those groups.

Some minority groups in Arizona were more likely than non-Hispanic whites to be college graduates — 47 percent of Asian-Pacific Americans and 83 percent of Subcontinent Asian Americans had at least a four-year college degree for the 2008-2012 time period.

[30] Feagin, Joe R. and Nikitah Imani. 1994. "Racial Barriers to African American Entrepreneurship: An Exploratory Study." *Social Problems*. 42 (4): 562-584.

All minority groups showed an increase between 2000 and 2008-2012 in the proportion of workers with a bachelor's degree.

Gender. Since 2000, the proportion of female workers in Arizona with at least a four-year college degree has surpassed that of men. Among workers in 2008-2012, about 31 percent of women and 29 percent of men age 25 and older had a bachelor's degree.

Figure E-9.
Percentage of all workers 25 and older with at least a four-year degree,
2000 and 2008-2012

Arizona	2008-2012	2000
Race/ethnicity		
African American	27.4 % **	23.2 % **
Asian-Pacific American	46.9 **	41.9 **
Subcontinent Asian American	82.7 **	77.5 **
Hispanic American	12.8 **	10.8 **
Native American	13.8 **	12.4 **
Other minority group	34.0	24.4 **
Non-Hispanic white	36.6 %	33.3 %
Gender		
Female	30.6 % **	27.6 % **
Male	29.4	28.7

Note: *,** Denote that the difference in proportions between the minority and non-Hispanic white groups (or female and male gender groups) for the given Census/ACS year is statistically significant at the 90% or 95% confidence level, respectively.

Source: Keen Independent Research from 2000 U.S. Census 5% sample and 2008-2012 ACS Public Use Microdata samples. The 2000 Census and 2008-2012 ACS raw data extracts were obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Additional indices of educational attainment. Other data sources showcase trends in post-secondary education among different racial/ethnic groups:

- College participation. The U.S. Department of Labor Bureau of Labor Statistics reported nearly 3 million students age 16 to 24 graduated high school in 2013 and about two-thirds enrolled in college, a rate unchanged from 2012.[31] The enrollment rate was highest for Asian American students (79%), followed by non-Hispanic white (67%), African American (59%) and Hispanic American (60%).

[31] College enrollment rates have remained relatively unchanged over the past 10 years, ranging from 66 to 70 percent.

Data published by the Arizona Minority Education Policy Analysis Center provide a demographic profile of Arizona resident students attending Arizona's public four-year institutions in 2010 as compared to 1991. The largest percentage of college students in 2010 were non-Hispanic whites (61%). This is a substantial decline from 1991, when 78 percent of college students were non-Hispanic whites. Hispanic American students now account for about 18 percent of the college population, a substantial increase from about 9 percent in 1991. The proportion of African American students has also doubled, from about 2 percent in 1991 to 4 percent in 2010. Asian American representation has increased from about 3 percent to 5 percent while the proportion of students who are Native American has remained unchanged at about 4 percent.

- Engineering-related degrees. Data from the National Science Foundation show approximately 4 percent of all bachelor's degrees in engineering fields awarded in the United States in 2010 were awarded to African American students. Asian Americans were awarded 12 percent of bachelor's degrees in engineering and Hispanic Americans were awarded 9 percent. Native Americans were awarded only 1 percent of engineering degrees in 2010.[32]

Employment. Figure E-10 compares the demographic composition of workers in the Arizona engineering industry to that of all workers in Arizona who are 25 years or older and have a college degree.

Race/ethnicity. In 2008-2012, about 18 percent of the workforce in the Arizona engineering industry was made up of minorities, as shown in Figure E-10. Of that workforce:

- About 2 percent was made up of African Americans;
- About 8 percent was made up of Asian Americans;
- About 9 percent was made up of Hispanic Americans; and
- About 1 percent was made up of Native Americans or other minorities.

In 2008-2012, all minorities considered together comprised about the same percentage of workers in engineering-related industries (24.2%) as workers 25 and older with at least a four-year college degree in other industries (23.5%). In engineering, African Americans accounted for 3 percent of workers with a four-year degree relative to about 4 percent of workers with a four-year degree in other industries. Asian Americans were about 5 percent of workers in engineering compared with 7 percent in all other industries. However, Hispanic American workers made up 15 percent of workers with a four-year college degree in engineering relative to 11 percent in of workers with a four-year degree in other industries. Native Americans and other minority groups accounted for about 2 percent of workers with college degrees for both engineering and other industries overall.

[32] The percentage of bachelor degrees in engineering awarded to non-Hispanic white students has remained relatively unchanged over the past ten years (71% in 2001 and 69% in 2010).

Non-Hispanic white Americans made up about 80 percent of engineering workers with a four-year degree relative to about 77 percent of workers in other industries with a four-year degree. Asian Americans made up 8 percent of engineering workers with a four-year degree relative to about 7 percent of similarly situated workers in other industries, though this difference was not statistically significant. Native Americans only made up about 1 percent of workers with four-year degrees in engineering and about 2 percent of workers with four-year degrees in other industries.

Gender. Compared to their representation among workers 25 and older with a college degree in all industries, relatively few women work in the engineering industry. In 2008-2012, women represented about 24 percent of engineering-related workers in Arizona with a four-year degree (among workers 25 and older) but 48 percent of workers in other industries with a four-year college degree.

Figure E-10.
Demographic distribution of workers age 25 and older with a four-year college degree, engineering and all other industries, 2008-2012

Arizona	Engineering		All other industries
Race/ethnicity			
African American	2.6 %	**	3.8 %
Asian American	4.7	**	6.8
Hispanic American	15.3	*	11.0
Native American or other minority	1.6		1.9
Total minority	24.2 %		23.5 %
Non-Hispanic white	75.8	**	76.5
Total	100.0 %		100.0 %
Gender			
Female	24.2 %	**	47.7 %
Male	75.8	**	52.3
Total	100.0 %		100.0 %

Note: *,** Denote that the difference in proportions between engineers and workers in all other industries for the given Census/ACS year is statistically significant at the 90% or 95% confidence level, respectively. The engineering industry includes "architectural, engineering and related services."

Source: Keen Independent Research from 2000 U.S. Census 5% sample and 2008-2012 ACS Public Use Microdata samples. The 2000 Census and 2008-2012 ACS raw data extracts were obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Civil engineers. Keen Independent also examined the number of minorities and women among civil engineers in Arizona in 2008-2012 (see Figure E-11). Overall, in 2008-2012, the percentage of civil engineers who were minorities (24%) was about the same as the percentage of all Arizona workers with college degrees in other industries who were minorities (24%).

Only 14 percent of civil engineers in Arizona were women in 2008-2012, substantially less than the percentage of workers with college degrees in other industries who were women (48%).

Figure E-11.
Demographics of workers age 25 and older with a college degree, civil engineering and all other industries, 2008-2012

Arizona	Civil engineering		All other industries
Race/ethnicity			
African American	2.9 %	**	3.8 %
Asian American	9.0	**	6.8
Hispanic American	8.8	**	11.0
Native American or other minority	3.6	**	1.9
Total minority	24.3 %		23.5 %
Non-Hispanic white	75.7	**	76.5
Total	100.0 %		100.0 %
Gender			
Female	13.5 %	**	47.7 %
Male	86.5	**	52.3
Total	100.0 %		100.0 %

Note: *,** Denote that the difference in proportions between civil engineers and workers in all other industries for the given Census/ACS year is statistically significant at the 90% or 95% confidence level, respectively.

Source: Keen Independent Research from 2000 U.S. Census 5% sample and 2008-2012 ACS Public Use Microdata samples. The 2000 Census and 2008-2012 ACS raw data extracts were obtained through the IPUMS program of the MN Population Center: http://usa.ipums.org/usa/.

Summary

Keen Independent's analyses suggest that there are barriers to entry for certain minority groups and for women in the construction and engineering industries in Arizona, as summarized below.

- Fewer African Americans worked in the Arizona construction industry than what might be expected based on representation in the overall workforce and analysis of educational requirements in the industry.
- Fewer African Americans and Asian Americans worked in the Arizona engineering industry than what might be expected based on analyses of workers 25 and older with a four-year college degree.
- Women accounted for particularly few workers in the Arizona construction and engineering industries.

Any barriers to entry in construction and engineering might affect the relative number of minority and female business owners in these industries in Arizona.

Keen Independent also examined advancement in the Arizona construction industry.

- Representation of minorities and women was much lower in certain construction trades (including first-line supervisors) compared with other trades.
- Compared to non-Hispanic whites working in the construction industry, African Americans, Asian Americans, Hispanic Americans and Native Americans were less likely to be managers.

Any barriers to advancement in the Arizona construction industry may also affect the number of business owners among those groups.

Appendix F, which follows, examines rates of business ownership among individuals working in the Arizona construction and engineering industries.